	Experiment title: X-ray microdiffraction characterization of bone reconstructed by human marrow stromal cells	**Experiment number**: **SC1196**
Beamline:	**Date of experiment**: from: 07/04/03 to: 10/04/03	**Date of report**: 29/08/03
Shifts:	**Local contact(s)**: Dr. Manfred BURGHAMMER	*Received at ESRF:*

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Report:

With this experiment we intended to give an important contribution to the characterization of the newly formed bone induced by bone marrow stromal cells (BMSC). A microdiffraction experiment has been performed to analyse the bone induced by BMSC loaded on a biomaterial scaffold and implanted in a mouse model.

The advanced microdiffraction technique we used is based on a X-ray waveguide (WG). We took advantage of an improved set-up installed at ID13 beamline at ESRF, where a new undulator is combined with a Compound Refractive Lens (CRL) stage and an horizontally focusing mirror. The emerging beam impinges on the waveguide and at the exit the X-ray beam of (0.1 X 3) μ^2 has a flux of $6x10^9$ ph/sec corresponding to a footprint on the sample of (0.3 x 3)μ^2 and a flux density of the order of 6 $x10^{15}$ ph/s/mm^2.

A piezo-scanning stage with 0.1 micron repeatability allows the sample to be vertically scanned through the sub-micro beam. The diffraction pattern of the sample is recorded by a MAR CCD detector. Two optical microscopes looking at the sample from top and from a side, allow the sample alignment and the monitoring of the small investigated sample region.

The newly formed bone grows on the internal surface of the scaffold pores and we examined a region of 200 microns near the pore surface by means of both low and high spatial resolution scans. The high flux density and the experimental conditions chosen allowed the simultaneous acquisition of both Wide Angle X-ray Scattering (WAXS) and Small Angle X-ray Scattering (SAXS) from the mineral part of the newly formed bone (Hydroxyapatite- HA). The complementary information coming from WAXS and SAXS clearly indicates the elongated shape of the bone grains and their orientation with respect to the scaffold. In

particular the measurements show that the new bone grows following the scaffold geometry and arranging the elongated grains parallel to the scaffold pore surface.
A detailed study of the interface between new bone and scaffold has been made with sub-micron spatial resolution. The analysis, which is still in progress, shows an interesting structural variation of the reflection 002 of the HA at this interface.
A paper concerning these data is in preparation.
This experiment was part of the approved PURS project of the I.N.F..M. (Istituto Nazionale di Fisica della Materia) concerning the study of bone produced by bone marrow stromal cells with X-ray Microscopy and Microdiffraction at high spatial resolution.